

# Building Confidence in Modeling and Simulation Results

- The usefulness of modeling and simulation is only as good as the confidence end users have in the results
- There are many things that are involved in creating that confidence
- The availability and applicability of good experimental data for validation is critical to building that confidence

We (almost) have the theoretical and computational power to validate AMS tools. But we might not have all the needed data.

- NEAMS and CASL are using the Predictive Capability Maturity Model (PCMM) to build "evidence packages" that will lead to user confidence. These will include information on:
  - Representation and geometric fidelity,
  - Physics and material model fidelity,
  - Code verification,
  - Solution verification,
  - Model validation, and
  - Uncertainty quantification and sensitivity analysis
- While new more "fundamental" codes might reduce the need for more integral experiments, they also create new challenges for experimental validation

The New Challenges

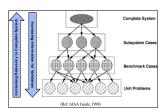
CRUD core-wide distribution
CRUD mass, composition, and morphology
Boron, additive R/Add transport
Corrosion product CP transport
Wiczofield
Transport
Microfield
Transport
Microf

Coolant chemistry/CRUD dimension of the CIPS framework

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### SAL Idaho National Laboratory Validation Data Requirements

- Understand specific requirements for validation data
- Physical phenomena of interest
- Single vs. integrated effects
- Measurement requirements
- Dimensionality
- Resolution
- Boundary conditions
- Times of measurements
- Uncertainties
- Intended uses of the simulation capabilities and specific quantities of interest



Validation Experiment Hierarchy

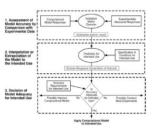
How do we manage this complexity?

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#### Prioritize Requirements

### Understand the priorities for validation data

- Utilize PIRT to understand the most important phenomena
- Utilize sensitivity and uncertainty to understand what validation data will provide the greatest impact
- Understand the timing of code releases and impact on the timing of the need for validation data

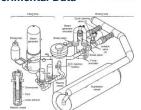


Validation Data Prioritization Factors to be Considered

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#### Fully Utilize Existing Experimental Data

- Due to cost, time, and environmental factors many previous experiments will never be done again
- Given validation data needs how can those previous experiments be used to meet requirements?
- Address questions like:
  - Where does the data reside?
  - What form?
  - How well does it meet the requirements identified in Element One and Two?
  - For existing data that does not fully meet requirements, what can be done to increase its usefulness

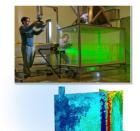


The Schematic of LOFT Facility

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#### Work with Experimental Programs to Maximize the Usefulness of New Data

- Work closely with current NE experimental activities (Reactor Technologies, and Fuel Cycle, NEUP, NEET Crosscuts)
- Communicate requirements for validation data to complement existing data
- Collaborate on the design of new experiments
- New methods
- New diagnostics
- Where appropriate utilize modsim capabilities to help design and execute new experiments



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New Innovative Experiments — MANTRA: A Nuclear Data Experiment in The Advanced Test Reactor at INL

- · Objective:
- Infer effective neutron capture cross-sections of most actinides of interest for reactor physics in fast and epithermal neutron spectra
- Emphasis on the quality and consistency of the fast and epithermal data (i.e. same samples, same fabrication protocols, same PIE protocols, same experimentalists, etc...)
- First-of-a-kind nuclear data experiment for ATR which is generally used for material irradiations
- First-of-a-kind PIE measurements at the ATLAS-AMS facility at ANL for this type of applications. The extreme sensitivity of the AMS should allow more information to be derived from each sample
- More highly accurate PIE measurements using ICPMS and TIMS at INL
- Two out of the three planned irradiations are already completed and PIE should be completed by January 2014



Improved nuclear data will benefit advanced modeling and simulation of future nuclear reactors and fuel cycles





